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WILLIAM HUGGINS, ESQ., F.R.S., President, in the Chair.

Sir David Salomons, B.A. Nat. Sc., Broom Hill, Tunbridge Wells;

John Bagnold Smith, Esq., The Laurels, Chesterfield;

William Thomas Smedley, Esq., 20, Colmore Row, Birmingham; and

Thomas Watson, Esq., J.P., F.R.G.S., 15, York Place, Portman Square;

were balloted for and duly elected Fellows of the Society.

An Instrument for Determining Spherical Triangles by Mechanical Action. By F. C. Penrose, Esq.

Two planes formed of wood or any suitable material are hinged so as to revolve with respect to each other, through an angle of 180°, on a common axis.

One of these planes is bounded by a semicircle, the other by a segment rather exceeding a quadrant, but both to the same radius.

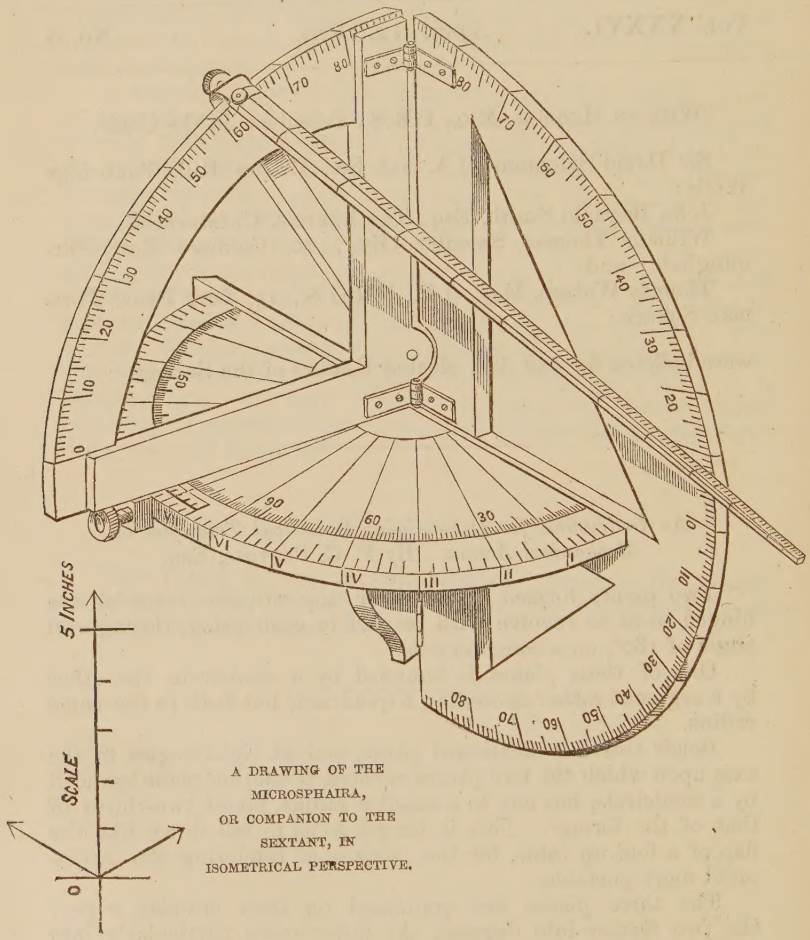
Below this last-mentioned plane, and at right angles to the axis upon which the two planes revolve, is another plane bounded by a semicircle, but cut to a smaller radius, about two-thirds of that of the former. This is hinged so as to fall down like the flap of a fold-up table, for the purpose of rendering the instrument more portable.

The three planes are graduated on their circular edges; the two former into degrees, the latter more particularly into divisions representing hours and minutes.

An arm or radius bar is centred so as to carry a point along the graduated edge of the quadrant, and from this point issues a

link, free at the other extremity, and graduated with a scale of chords measured from a circle of the larger radius mentioned.

This link, by means of an universal joint at the point first described, is enabled to be placed in any direction, and can thus be applied to any part of the graduated edge of the semicircle first mentioned, namely, that which is hinged upon the same axis as the quadrant. Clamps are placed upon the radius bar, and upon the extremity of the quadrant plane, so that they may be fixed in any position that may be desired.



A DRAWING OF THE MICROSPHAIRA, OR COMPANION TO THE SEXTANT, IN ISOMETRICAL PERSPECTIVE.

By means of these three graduated arcs and the free link, any ordinary problem in spherical trigonometry can be determined by mere inspection and without calculation: the most usual

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cases in one operation, and others somewhat more complex in two.

For instance, if three sides are given and combined on the instrument, one of the angles will be shewn on the semicircular plane; or if an angle and two sides are given and combined upon the instrument, the third side can be read off upon the free link or upon the semicircle, according to the nature of the problem; but if two sides and an angle are given and an angle is required, or if two angles and a side are given, two operations would be necessary. They can be performed, however, with great rapidity.

The instrument can be used as a useful check to logarithmic computations; and as its accuracy is not inconsiderable [for instance, in a well-made instrument it would determine the hour-angle, or the azimuth from an altitude of the Sun, &c., taken near the prime vertical to about 20 seconds of time or 5′ of arc], it might sometimes stand in the place of logarithmic computations altogether, and be used as the companion to the sextant by navigators and travellers in unexplored regions; and especially so since by far the most accurate purpose to which it can be applied (so far as my experience of it enables me to speak) is in reducing the ordinary Lunar distance observation, by performing on the instrument the operation of "clearing the distance"—for the ratio between the effect of parallax on the measured distance and the parallax in altitude, can be found very readily and to a degree of accuracy not inferior to any other approximate method. The error, for instance, would scarcely ever exceed five seconds of arc; and a few printed tables can be affixed to the blank parts of the instrument to render it, for lunar measures, independent of all books, except the *Nautical Ephemeris*.

Radiant-Points of Shooting Stars. By William F. Denning, Esq., F.M.S.

(*Communicated by R. S. Greg, Esq., F.R.A.S., F.G.S.*)

The following Radiant-Points have been deduced from the observed paths of nearly 900 shooting stars, seen during the last four years at Bristol. The positions (which are chiefly those of the primary meteor-showers) have been ascertained by pencilling the courses on a Cary's 18-inch globe, and prolonging them backwards, the average places of convergence being selected as the approximate areas of radiation. The results were obtained independently of any previously published list; and a later reference to the valuable data of Professor Herschel, Mr. Greg,

Dr. Schmidt, Capt. Tupman, and others, tabulated in the annual reports of the Luminous Meteor Committee of the British Association, show that in many cases there is a close agreement.

No. 1876. Denning.	Dates of Observations.	Radiant-Point. R.A.	Dec. N.	Name or Position of Radiant.	No. in Greg's List, 1874.	Remarks.
		°	°			
1	1873 Jan. 2–3	234	48	North of α Boötis.	6	A marked shower.
2	1876 Mar. 12–17	184	54	ε Ursæ Majoris.	21	Also at *Cor Caroli*.
3	1874 April	223	45	Hercules.	48	3° N. of β.
4	1873–4 April	241	69	Draco.	57	Near ζ; same as 10?
5	1873–4 April	268	85	Polaris.	60	A marked shower.
6	1874 April	209	3 S.	Virgo.	62	12° E. of α.
7	1873–4 April 19–20	274	37 N.	Lyraids.	51	Mean of two showers; well observed.
8	1873 April 19—May 1	221	20	Boötes.	?	9° E. of α; doubtful.
9	1874 April 20	242	25	Corona.	67	9° E. of α.
10	1873 April 21	283	59	Draconids.	64	Precise at *o Draconis*.
11	1873 Apr. 21—May 1	173	64	Ursa Major.	?	Doubtful.
12	1873 April 21—May 1	189	60	ε Ursæ Majoris.	46	Connected with 2?
13	1873 June 25—July 8	164	57	Ursa Major.	76	Near β.
14	1873 July	267	49	Eridanus.	78	Near γ.
15	1875 July 7	344	27	β Pegasi.	96	Same as *Pegasids*?
16	1873 July 26—Aug. 11	2	27	α Andromedæ.	103	Identical with 17?
17	1873 Aug. 2–11	10	42	Andromeda.	98	Near the Nebula.
18	1871 Aug. 10	37½	58½	Perseids.	108	Central region well observed.
	1874 Aug. 10	44	58½			
19	1874 Oct. 17–18	34	18	Aries.	154	6° S.E. of α.
20	1874 Oct. 18–19	88	11	Orionids.	157	2° N. of υ.
21	1874 Oct. 19—Nov. 10	71	43	Auriga.	136	Near *Capella*.
22	1872 Nov. 6–10	64	20	Taurids.	156	Well observed.
23	1872 Nov. 27	29	46	γ Andromedæ.	172	A great shower.
24	1875 Dec. 19–23	277	73	χ Draconis.	?	Doubtful.
25	1872 Dec. 31	140	45	Ursa Major.	2	7° S. of θ.
26	1872 Dec. 31	164	20	δ Leonis.	?	Doubtful.
27	1872 Dec. 31	106	36	Geminids.	178	Near *Castor*.

Of the August shower in 1871, 260 meteors were seen in 8¾ hours on the 9th, 10th, and 11th. In 1874, 281 were counted

in 4 hours, and 252 of them were Perseids. Of the April shower in 1873 18 Lyraids were seen, and 14 in 1874. In regard to the minor displays, the radiant-points have been determined from a smaller number of meteors, but in cases (and they were found numerous) where the number were insufficient to indicate them, the observations were discarded.

Mr. Greg's List (1874), to which references are made in the table, is published in *British Association Report*, 1874.

Observed Courses of 71 *Bright Shooting Stars, seen at Bristol from November* 1872 *to March* 1876.

By William F. Denning, Esq., F.M.S.

(*Communicated by R. S. Greg, Esq., F.R.A.S., F.G.S.*)

The bright shooting stars, whose apparent paths are recorded in the following list, were seen either during occasional watches for them or casually. The table only includes those estimated to equal or excel 1st mag. stars, and does not comprise the total number of such meteors seen here within the interval mentioned, for during the fine showers of November 27, 1872, and August 10, 1874, the paths of many of them were not noted, attention being mainly directed to the aggregate numbers visible, to eye-estimations of the radiant-points, and to other details.

The times of apparition may be relied on as accurate to within a minute or so; but in some cases a meteor was observed by me when absent from home, and on such occasions a watch had to be consulted for the time, which, however, I afterwards verified, and hence there is little chance of error on this account.

The magnitudes given are those of *maximum* brilliancy, and the comparisons are with planets or 1st mag. stars.

The observed paths were projected on a celestial globe, and the R.A.'s and Declinations of beginning and ending, together with the length of path, read off, the latter element being less carefully noted than the two former, which give the more important one of *direction*.

I have affixed a column giving the probable "Radiant by stars," and in finding these positions referred, in many doubtful cases, to Mr. Greg's "General Comparative Table of Radiant Positions and Durations of Meteor Showers" (*B. A. Report*, 1874), which is continued and extended from a similar catalogue by the same author in the *Monthly Notices R. A. S.*, vol. xxxii., pp. 345–55.

The column of "Notes" indicates either the path of the meteor amongst the stars, the rate of motion, or the appearance of a train and its duration.

List of the Observed Courses of 71 Bright Shooting Stars, seen at Bristol during the Period from November 1872 to March 1876.

	Date.	Mean Time.	Mag.	Observed Path. From R.A.	From Dec. N.	To R.A.	To Dec. N.	Length of Path	Direction or Radiant by Stars.	Notes.
	1872.	h m		°	°	°	°	°		
1	Nov. 23	7 20	> ♀	18	44	131	63	60	γ Andromedæ.	2 secs.; long path.
2	25	8 5	1	150	63	165	61	7	α Aurigæ.	Between the Pointers.
3	27	5 50	♀	162	69	171	60	10	γ Andromedæ.	Fireball; slow; sparks.
4-7	,,	5 55	1	159	77	182	58	20	γ Andromedæ.	Average course of 4 bright meteors, seen in rapid succession, in a clear space in North.
8	28	5 45	1	55	74	73	27	22	α Persei.	↓ Fell vertically, leaving sparks.
9	Dec. 2	9 30	Sirius	154	78	268	76	22	Gemini?	Train for 2 secs.; across *Ursa Minor*.
10	26	7 58	> ♀	343	22	338	4 S.	26	β Pegasi.	Fireball; illuminated sky, like lightning.
11	31	12 27	1	164	15	162	3 N.	13	δ Leonis.	In *Leo*.
12	,,	12 42	Sirius	130	5 S.	140	25 S.	21	θ Geminorum.	1½ sec.; west of *Cor Hydræ*.
	1873.									
13	Apr. 19	9 28	1	295	46	316	51	14	α Lyræ.	Slow; through *Cygnus*.
14	20	9 28	1	292	55	360	72	32	α Lyræ.	Slow; train; long path.
15	,,	10 55	1	225	19	246	16	20	α Boötis.	Slow; just above β and γ *Serpentis*.
16	21	11 7	1	295	45	309	49	10	α Lyræ.	Train; began near δ *Cygni*.
17	30	9 25	1	218	14	233	13	14	α Boötis.	Train 1½ sec.; slow.
18	May 1	9 15	1	181	24	182	2	21	ε Ursæ.	Train 1 sec.; slow.

19	June 25	10 58	1	132	56	120	53	6	β Ursæ.	↘ Towards *Lynx*.
20	28	11 12	1	298	87	336	73	14	β Ursæ.	↗ Inclined upwards from *Polaris*.
21	July 20	9 26	1	124	62	106	52	19	Hercules.	↘ Towards *Lynx*.
22	28	11 32	♃	210	49	200	38	14	β Pegasi.	↓ *η Ursæ* to *Cor Caroli*.
23	,,	11 48	1	202	44	193	36	10	Draco?	Rapid; 2° E. of *Cor Caroli*.
24	30	10 45	1	42	43	45	36	8	χ Persei.	Near *Algol*.
25	Aug. 2	11 40	♃	43	54	62	56	12	β Pegasi.	↙ Began near *η Persei*.
26	7	9 33	2 × ♀	190	59	195	30	30	Polaris?	Train for 7 secs.; a fireball.
27	9	10 15	♀	41	75	196	73	30	χ Persei.	← Long path.
28	,,	10 29	1	37	45	50	42	10	ζ Cygni.	↙ Rapid; between α and β *Persei*.
29	,,	11 25	1	337	59	304	50	20	χ Persei.	↗ Inclined upwards.
30	,,	11 29	1	28	41	12	46	12	Pleiades,	↑ Shot upwards; train for 3 secs.
31	11	8 57	1	360	35	353	27	11	χ Persei.	→ Horizontally.
32	,,	9 11	1	11	40	21	29	13	δ Cephei.	↓ Vertical; slow.
33	Dec. 17	7 48	1	284	65	283	57	8	Draco?	Rapid.
34	22	7 59	1	59	44	39	52	16	α Aurigæ.	Rapid; across α *Persei*.
	1874.									
35	Jan. 6	10 20	1	...	...	...	...	...	...	↓ Slightly east of *Cor Hydræ*; almost vertical; near horizon; very slow; red; Radiant at *θ Gem.*; seen in bright moonlight.
36	Apr. 11	9 18	♃	243	47	278	50	24	β Boötis.	Very slow; near β and γ *Draconis*.
37	19	10 11	1	218	13	216	4 S.	17	β Boötis.	Train; began at ζ *Boötis*.
38	20	10 6	1	268	46	276	32	15	Draco?	Train; west of α *Lyræ*.

No	Date.	Mean Time.	Mag.	Observed Path Fmro R.A.	Fmro Dec. N.	To R.A.	To Dec. N.	Length of Path.	Direction or Radiant by Stars.	Notes.
	1874.	h		°	°	°	°	°		
39	April 20	11 48	1	280	26	286	13	15	α Lyræ.	Train; towards ε and ζ *Aquilæ*.
40	„	12 31	1	280	8	283	2 S.	11	α Lyræ.	Rapid; near horizon.
41	„	12 49	1	313	30	326	26	10	α Lyræ.	Rapid; across ζ *Cygni*.
42	Aug. 18	11 36	Sirius	24	36	68	44	33	α Andromedæ.	Slow; long path.
43	Sept. 1	8 49	?	...	...	...	...	...	...	Bright meteor; train; under η *Ursæ Majoris* for several minutes; an intense flash seen through clouds at the time stated.
44	6	8 40	2	275	20	255	12 S.	37	δ Cygni.	Long path; train 1 sec.
45	Oct. 18	10 48	1	19	32	5	43	16	α Arietis.	Rapid; across the Nebula in *Andromeda*.
46	19	11 35	1	58	23	56	12	11	ν Orionis.	Rapid; train.
47	21	7 59	1	281	54	257	50	15	α Andromeda.	Very rapid; between β and γ *Draconis*.
48	„	11 6	Sirius	56	4	32	4 S.	25	ν Orionis.	Bright train; rapid.
49	22	7 34	1	142	56	129	58	10	?	Rapid; in *Ursa Major*, near θ.
50	31	8 23	1	169	77	137	60	19	Lyra.	Very slow.
51	Nov. 7	5 58	Sirius	313	70	335	57	16	Ursa Minor.	Very rapid; through *Cepheus*.
52	10	8 38	1	134	48	153	46	13	α Tauri.	Slow; between θ and λ *Ursæ*.
53	„	11 0	> ♀	43	30	7	4 S.	47	ν Orionis.	Very slow; long train, for 3 secs.; white.
54	„	11 11	1	20	6 S.	14	12 S.	9	ν Orionis.	A mere flash.
55	11	9 44	♀	31	6 S.	24	13 S.	9	α Tauri.	Slow; from *Mira* to ζ *Ceti*.

	1875.										
56	July	7	10 54	♃	37	64	25	47	15	β Ursæ.	Under *Cassiopeia*.
57		,,	12 2	♀	357	37	15	48	17	β Pegasi.	Train for 3 secs. } ↓2 ←1
58		,,	,, ,,	♃	At right angle to preceding.					...	Left train for 1 sec. }
59	Aug.	1	9 25	♃	126	53	125	46	7	Polaris.	Rapid; train for 2 secs.
60		8	10 10	?=♀	...	...	...	...	...	...	Near π *Pegasi*, from χ *Persei*; long bright train, visible behind clouds.
61		26	10 30	=♀	41	63	64	63	10	β Pegasi.	↙ No train.
62	Dec.	12	6 36	♂	146	40	159	40	9	θ Geminorum.	Near horizon; very slow; red; seen in bright moonlight.
63		13	10 8	♃	142	52	185	52	26	θ Geminorum.	Very slow; seen in bright moonlight.
64		23	8 44	♃	93	44	93	16	28	Draco.	Slow; across μ *Geminorum*.
65		,,	9 27	♀	38	60	10	63	13	α Aurigæ.	Rapid; across ε *Cassiopeiæ*.
	1876.										
66	Jan.	31	9 13	?♀	64	12 S.	60	30 S.	18	α Tauri.	↓ Almost vertical; seen through clouds.
67	Feb.	2	8 31	♂	175	31	185	35	9	γ Leonis.	Slow; above *Coma Berenices*.
68		4	7 35	=$\frac{1}{5}$th☽	74	4	50	1 S.	25	γ Leonis?	→ From γ *Orionis* to α *Ceti*.
69		29	6 35	♀	358	52	357	59	7	?	Very slow; ↗ just below β *Cassiopeiæ*.
70	Mar.	1	6 46	♃	...	...	...	...	...	...	↘ Very bright; shot near ζ and ν *Ursæ Majoris* in E.N.E.; long path, from α *Persei* or ε *Ursæ Maj*.
71		17	8 15	♀	145	10	135	7 S.	20	ε Ursæ.	↘ Train; to W. of *Cor Hydræ*.

On the Most Probable Result which can be derived from a Number of Direct Determinations with Assigned Weights. By E. J. Stone, Esq., M.A., F.R.S., Her Majesty's Astronomer at the Cape of Good Hope.

The proof of this case can be made to follow step by step that given by me in the *Monthly Notices*, vol. xxxiii., November 1873.

Let $x_1, x_2, \ldots . x_n$ be the direct measures; and $\omega_1, \omega_2, \ldots . \omega_n$ the assigned weights, or numbers proportional to the supposed accuracy of the separate results. Then since, by assumption, an error $\frac{h}{\omega_1}$ in x, is to be considered as equally probable with errors $\frac{h}{\omega_2}, \frac{h}{\omega_3}, \ldots . \frac{h}{\omega_n}$ in $x_2, x_3, \ldots . x_n$ respectively, the function of $x_1, x_2, \ldots . x_n$, which represents the most probable values *with the assigned weights* must depend upon the independent variables in such a way that errors, or arbitrary changes, $\frac{h}{\omega_1}, \frac{h}{\omega_2}, \ldots . \frac{h}{\omega_n}$ in $x_1, x_2, \ldots . x_n$ respectively, produce equal errors, or arbitrary changes, in the most probable value.

If therefore ϕ denote the most probable value, since

$$\phi\left(x_1+\frac{h}{\omega_1}\right), \quad \phi\left(x_2+\frac{h}{\omega_2}\right), \ldots . \phi\left(x_n+\frac{h}{\omega_n}\right)$$

are equal for all values of h, we see on comparing the coefficients of h in the expansions that

$$\frac{1}{\omega_1}\cdot\frac{d\phi}{dx_1} = \frac{1}{\omega_2}\cdot\frac{d\phi}{dx_2} = \ldots . = \frac{1}{\omega_n}\cdot\frac{d\phi}{dx_n},$$

$$\frac{1}{\omega_1^2}\cdot\frac{d^2\phi}{dx_1^2} = \frac{1}{\omega_2^2}\cdot\frac{d^2\phi}{dx_2^2} = \ldots . = \frac{1}{\omega_n^2}\cdot\frac{d^2\phi}{dx_n^2},$$

or generally

$$\frac{1}{\omega_1^r}\cdot\frac{d^r\phi}{dx_1^r} = \frac{1}{\omega_2^r}\cdot\frac{d^r\phi}{dx_2^r} = \ldots . = \frac{1}{\omega_n^r}\cdot\frac{d^r\phi}{dx_n^r}.$$

From these equations of condition we see that

$$\frac{1}{\omega_1^2}\cdot\frac{d^2\phi}{dx_1^2} = \frac{1}{\omega_1\omega_2}\cdot\frac{d^2\phi}{dx_1\,dx_2}.$$

Similarly we have generally—

$$\frac{1}{\omega_1^{r+s}}\cdot\frac{d^{r+s}\phi}{dx_1^{r+s}} = \frac{1}{\omega_1^r\,\omega_2^s}\cdot\frac{d^{r+s}\phi}{dx_1^r\,dx_2^s}.$$

Now let

$$x_1 = s+h_1, \quad x_2 = s+h_2, \ldots . x_n = s+h_n, \qquad \text{(A)}$$

Then

$$u = \phi(x_1, x_2, \ldots . x^n)$$
$$= \phi(s+h_1, s+h_2, \ldots . s+h_n)$$
$$= \phi(s, s, s)$$
$$+\left(h_1 \frac{d}{dx_1} + h_2 \frac{d}{dx_2} + \ldots . + h_n \frac{d}{dx_n}\right)\phi$$
$$+\left(h_1 \frac{d}{dx_1} + h_2 \frac{d}{dx_2} + \ldots . + h_n \frac{d}{dx_n}\right)^2 \frac{\phi}{1.2} + \&c.$$
$$+\left(h_1 \frac{d}{dx_1} + h_2 \frac{d}{dx_2} + \ldots . + h_n \frac{d}{dx_n}\right)^r \frac{1}{\lfloor r} \phi(S+\theta h_1, S+\theta h_2, \ldots . S+\theta h_n)$$
$$= \phi(s, s, s) + (\omega_1 h_1 + \omega_2 h_2 + \ldots . + \omega_n h_n) \frac{1}{\omega_1} \frac{d\phi}{dx_1}$$
$$+\left(\frac{\omega_1 h_1 + \omega_2 h_2 + \ldots . + \omega_n h_n}{1.2}\right)^2 \frac{1}{\omega_1^2} \frac{d^2\phi}{dx_1^2} + \&c.$$

Now let

$$s = \frac{\omega_1 x_1 + \omega_2 x_2 + \ldots . + \omega_n x_n}{\omega_1 + \omega_2 + \ldots . + \omega_n};$$

in this case we see from (A) that

$$\omega_1 h_1 + \omega_2 h_2 + \ldots . + \omega_n h_n = 0 \text{ identically,}$$

and therefore

$$u = \phi(s, s, s) = F\left(\frac{\omega_1 x_1 + \omega_2 x_2 + \ldots . + \omega_n x_n}{\omega_1 + \omega_2 + \ldots . + \omega_n}\right).$$

Let

$$\frac{\omega_1 x_1 + \omega_2 x_2 + \ldots . + \omega_n x_n}{\omega_1 + \omega_2 + \ldots . + \omega_n} = z;$$

then

$$u = F(z) = F(0) + z F'(0) + \frac{z^2}{1.2} F''(0) + \&c. + \frac{z^n}{\lfloor n} F^n(\theta z),$$

where

$$F(0), \quad F'(0), \quad F''(0), \quad \&c.$$

are independent of z, and therefore of

$$\omega_1, \ \omega_2, \text{ and } \omega_n.$$

But when

$$\omega_1 = \omega_2 = \omega_3 = \ldots . = \omega_n,$$
$$u = F(z) = z$$

$$\therefore F(0) = 0, \quad F'(0) = 1, \quad F''(0) = 0, \quad \&c. \ldots . \quad F = 0;$$

or

$$u = z = \frac{\omega_1 x_1 + \omega_2 x_2 + \ldots . + \omega_n x_n}{\omega_1 + \omega_2 + \ldots . + \omega_n}.$$

A discussion of the case for equal weights depending upon my fundamental axiom has appeared in the *Astronomische Nachrichten*, No. 2,068, by Professor Schiaparelli; and since no acknowledgment of my work is made in that paper, I presume the principle has been independently arrived at.

Royal Observatory, Cape of Good Hope, 1876, *Feb.* 14.

A List of Stars beyond the ordinary Limits of Distance inserted as Double in Sir John Herschel's General Catalogue of Double Stars. By M. Camille Flammarion.

(*Communicated by the Rev. R. Main.*)

The List includes such as have no comparison within the limits ordinarily assigned, namely, 2 minutes of arc.

No. in Catalogue.	Name of Star.	No. in Catalogue.	Name of Star.
3	β Cassiopeiæ	1357	19 Tauri
30	γ Pegasi	1637	Σ (445) C.G.
172	κ Cassiopeiæ	1639	θ^1 Tauri
210	ζ Cassiopeiæ	1760	9 Camelopard.
221	S.C.C. 19	1802	Σ (483)
255	S.C.C. 26 β Ceti	1822	3 Aurigæ
323	γ Cassiopeiæ	1841	Σ (493)
403	η Ceti	1859	ζ Aurigæ
405	β Andromedæ	1890	η Aurigæ
410	32 Cassiopeiæ	1960	Capella
495	δ Cassiopeiæ	2070	β Tauri
679	ϵ Cassiopeiæ	2162	Σ (597)
687	ζ Ceti	2179	Σ (605)
706	56 Andromedæ	2187	ϵ Orionis
783	α Arietis	2274	28 Aurigæ
850	Arietis	2348	α Orionis
893	Σ (229) Cat. Gen.	2360	β Aurigæ
926	13 Trianguli	2398	Σ (666)
1120	α Ceti	2416	Σ (672)
1141	β Persei	2441	Σ (676)
1217	τ^4 Eridani	2502	Σ (696)
1218	α Persei	2504	Σ 870
1325	δ Persei	2509	2 Lyncis
1354	17 Tauri	2510	Σ (700)

No. in Catalogue.	Name of Star.	No. in Catalogue.	Name of Star.
2563	Σ (719)	4982	Σ (1332)
2589	ζ Canis Maj.	5044	χ Ursæ Maj.
2601	Σ (723)	5066	β Leonis.
2850	Σ (780)	5074	β Virginis
2932	Σ (805)	5095	γ Ursæ Maj.
2949	25 Camelop.	5146	Σ (1592)
3187	Σ (877)	5233	δ Ursæ Maj.
3188	Σ (878)	5262	Σ (1409)
3209	Σ (884)	5340	κ Draconis
3215	Σ (888)	5398	Σ (1460) C.G.
3542	Σ (959)	5436	ϵ Ursæ Maj.
3556	Σ (964)	5591	Spica
3642	Σ (982)	5653	Σ (1537)
3665	Σ (989)	5749	η Ursæ Maj.
3676	ι Ursæ Maj.	5860	α Draconis
3728	Σ (1006)	5919	Arcturus
3770	Σ (1015)	5992	θ Boötis
3827	Σ (1031)	6025	γ Boötis
3842	Σ (1036)	6126	α^1 Libræ
3883	Σ (1051)	6194	β Ursæ Min.
3972	κ Ursæ Maj.	6215	110 Virginis
4007	Σ (1080)	6394	γ Ursæ Min.
4070	Σ 1328	6431	α Coronæ
4149	Σ (1116)	6555	ζ Ursæ Min.
4163	α Hydræ	6601	θ Draconis
4180	θ Ursæ Maj.	6608	Σ (1782)
4260	Σ (1147)	6696	Σ (1814)
4447	λ Ursæ Maj.	6748	Σ (1836)
4455	Σ (1189)	6765	σ Herculis
4479	μ Ursæ Maj.	6877	Σ (1884)
4489	Σ (1200)	6887	ϵ Herculis
4758	β Ursæ Maj.	6919	Σ (1901)
4768	α Ursæ Maj.	6925	Σ (1903)
4789	Σ (1277)	6939	ϵ Ursæ Min.
4838	Σ (1290)	6991	Σ (1927)
4877	Σ (1303)	7004	Σ (1932)
4930	λ Draconis	7068	α Ophiuchi
4941	Σ (1319)	7092	Σ (1968)
4946	Σ (1321)	7100	ι Herculis

No. in Catalogue.	Name of Star.	No. in Catalogue.	Name of Star.
7101	Σ (1971)	8510	Σ (2457)
7102	Σ (1972)	8531	γ Cygni
7103	Σ (1973)	8728	α Cygni
7143	Σ (1993)	8771	Σ (2522)
7155	Σ (1998)	8782	η Cephei
7186	Σ (2010)	8875	Σ (2544)
7219	θ Herculis	8892	62 ξ Cygni
7221	ξ Draconis	8973	Σ (2578)
7240	γ Draconis	8982	77 Draconis
7261	Σ (2039)	9028	α Cephei
7330	Σ (2064)	9051	Σ (2596)
7440	Σ (2103)	9259	Σ (2634)
7449	χ Draconis	9385	α Aquarii
7469	δ Ursæ Min.	9412	Σ (2668)
7474	Σ (2114)	9445	Σ (2675)
7560	Σ (2147)	9458	ζ Cephei
7690	γ Lyræ	9487	Σ (2691)
7692	Σ (2201)	9513	Σ (2699)
7722	Σ (2213)	9556	3 Lacertæ
7770	Σ (2239)	9616	7 Lacertæ
7779	Σ (2242)	9618	Σ (2728)
7879	δ Draconis	9713	Σ (2747)
7961	π Draconis	9736	Err. of 2^m=9723
7979	α Vulpeculæ	9745	Σ (2754)
8048	Σ (2326)	9777	ι Cephei
8109	Σ (2342)	9878	α Pegasi
8135	γ Aquilæ	9906	Σ (2787)
8312	Σ (2403)	9910	Σ (2789)
8379	Σ (2420)	10083	Σ (2830)
8422	Piazzi xx. 38	10116	λ Andromedæ

Note on the Two Exterior Satellites of Uranus.

By the Rev. T. W. Webb.

The admitted extreme faintness of even the brighter satellites of *Uranus*, the discouraging opinion of Sir John Herschel, and the utter hopelessness of Admiral Smyth as to grasping what he calls these "terrible objects to attack," may well account for the little attention which they have commonly received. It seems to have been reserved for the present favourable opposition of

the planet, to displace this idea of extreme difficulty from its long-established possession, and to show that these bodies, minute as they are, may be within the reach of the optical means, not only of our principal Observatories, but of a large porportion of amateurs. This fact appears to have been sufficiently established by Mr. Isaac William Ward, of Belfast, an accurate and persevering observer of considerable experience, whose success in the detection of many very minute *comites* vouches at once for the keenness of his vision and the excellence of his object-glass, which is one of Wray's, with an aperture of 4·3 inches. And I beg permission of the Society to lay before them the evidence which Mr. Ward has placed at my disposal, and which he has drawn up in a tabular form. The first observation, as he has remarked, is of course not connected with any satellite. The rest were mere glimpses, as may be supposed, obtained by most intense gazing, and with averted vision only.

The value and interest of these observations arise from the circumstance that in every instance the estimations were made quite independently, without previous reference to any Ephemeris; in fact, with regard to those in February and March, Mr. Ward had not at the time any tables in his possession. There is, of course, a possibility that the presence of very minute stars may have been a source of illusion, as it undoubtedly was with regard to other supposed satellites in the case of Sir W. Herschel; but considering the number of coincidences, the fair degree of approximation, the similarity of aspect in each instance, and the motion of the planet, it may perhaps be conceded that the balance of probability inclines strongly in Mr. Ward's favour.

I may be allowed to add, that, stimulated by Mr. Ward's information, and encouraged by the opinion of another experienced observer, I turned my beautiful 9·38-inch silvered glass "With" speculum to *Uranus* on the night of March 24, one of the very few favourable ones during the present season. With considerable difficulty, but without adopting indirect vision, I had occasional glimpses with a power of 212 of a very minute point in the *n f* quadrant, which, though of the most evanescent character, always when visible occupied the same position: and this was entirely confirmed by a power of 450. The next morning I found from the Ephemeris of Mr. Marth, to whom my especial thanks, and not mine alone, are due, that my very rough guess of a position-angle of about 30°, obtained merely from the motion of the planet or swinging the tube, might have either indicated *Titania* at 44° or *Oberon* at 23°. I noted the distance less carefully, and, from recollection only, supposed it might have been about 30″. *Titania* was then 24″, *Oberon* 41″. If I saw either, it was probably the former, as *Oberon* would have been less likely to be noticed near the edge of the very contracted fields I employed. Such an observation, standing singly, is of course worthless, and I have had no opportunity of repeating it; it is only in connexion with those of Mr. Ward that I could venture to mention it at all.

Observations of the Two Outer Satellites of Uranus, with 4·3-in. Refractor (Wray), 240 power, at Belfast, by Isaac Wm. Ward.

Lat. 54° 36′ N.
Long. 5° 56° W. from Greenwich.

Date. 1876.	Hour. ±	Titania. Position. Ephemeris.* ±	Titania. Position. Observed. ±	Titania. Distance. Ephemeris. ±	Titania. Distance. Observed. ±	Oberon. Position. Ephemeris. ±	Oberon. Position. Observation. ±	Oberon. Distance. Ephemeris. ±	Oberon. Distance. Observation. ±	
		°	°	″	″	°	°	″	″	
Jan. 15	13 hours	...	...	...	...	...	...	...	...	An elongation of Planet's limb, in direction of P 25°, like an occultation of a star.
20	13 ,,	...	...	...	...	330	330	29	30–40	
21	13 ,,	167	120	28	35	...	...	...	...	
26	13 ,,	320	330	20	25	167	170	38	35	
Feb. 1	12 ,,	34	30	27	25–30	359	360	44	50?	A faint point at ± P 260° and 25–30″ D.
3	11½ ,,	350	360	29	50?	...	...	...	...	A point at ± P 70° and 25″ ± D.
19	12 ,,	19	20	33	30	209	250?	39	25?	A faint point at ± P 120° and 25′ ± D.
23	12 ,,	207	200	30	30	...	...	...	...	
Mar. 1	11 ,,	312	...	...	...	306	310	24	30	
16	10 ,,	24	70?	32	25?	233	170?	29	30	
17	10 ,,	2	10	32	25	208	200	39	40	
21	10 ,,	186	200	34	35	129	140	26	25	

* In the *Astronomical Register*.